

# MAIN GOVERNING PARAMETERS OF ACTIVATED SLUDGE UNIT DESIGN

• AERATION PERIOD (Detention Time)

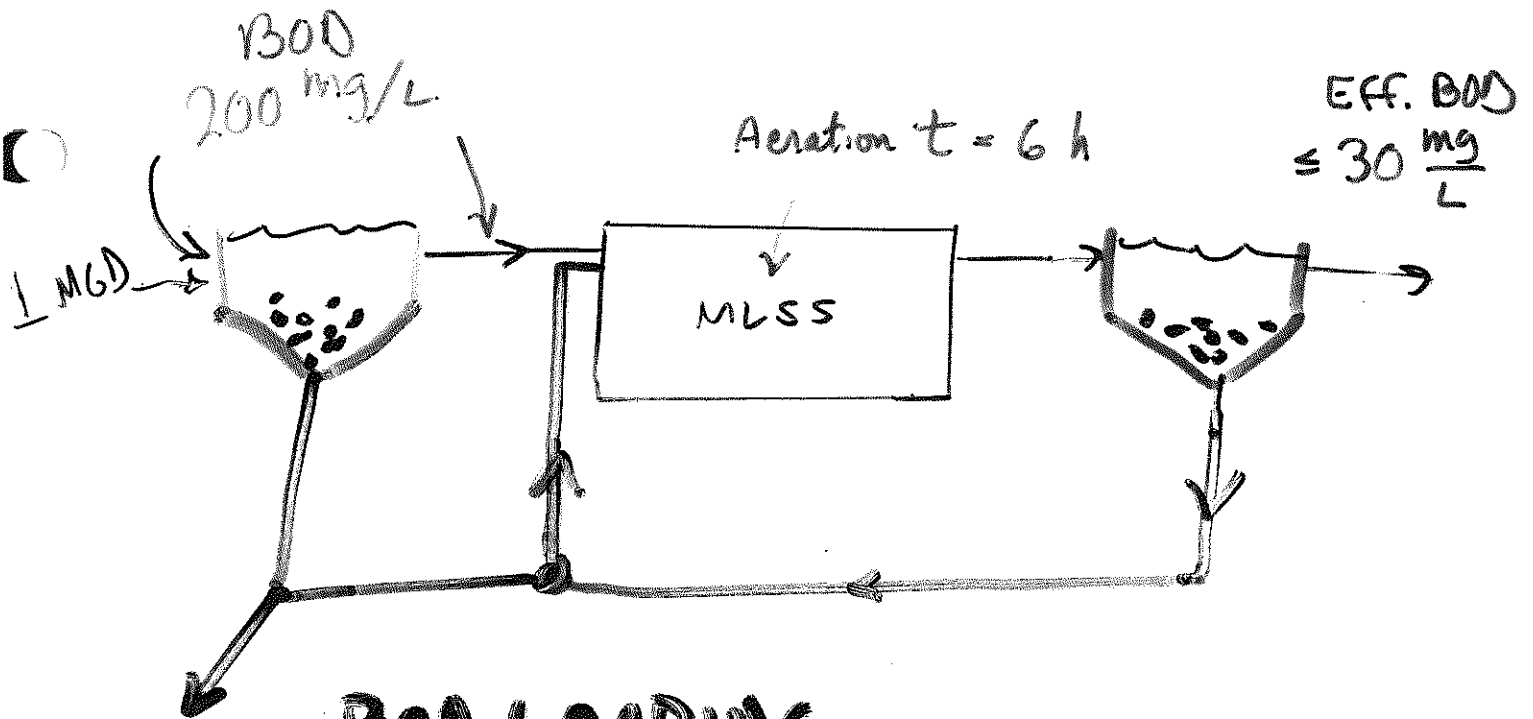
• SLUDGE AGE (MEAN CELL RESIDENCE TIME)

CONVERSION:  $\text{BOD} \frac{\text{mg}}{\text{L}} \times \frac{62.4}{1000} = \text{BOD} \frac{\text{lb}}{1000 \text{ ft}^3}$

$\left( \text{BOD} \frac{\text{lb}}{1000 \text{ ft}^3} \right) \times \left[ \frac{24 \text{ h/d}}{t_d, \text{ h}} \right] = \text{LOADING IN} \frac{\text{lb BOD}}{1000 \text{ ft}^3 \cdot \text{d}}$

SLUDGE AGE =  $\frac{\text{MLSS} \left( \frac{\text{mg}}{\text{L}} \right) \times V (\text{L})}{\left[ \text{SS}_e \left( \frac{\text{mg}}{\text{L}} \right) \times Q_e \left( \frac{\text{L}}{\text{d}} \right) \right] + \left[ \text{SS}_w \left( \frac{\text{mg}}{\text{L}} \right) \times Q_w \left( \frac{\text{L}}{\text{d}} \right) \right]} = \frac{\text{mg of MLSS}}{\text{mg-solids "lost" day}}$

Typically 5-15 days → = days spent in system



## BOD LOADING

$$10 - 100 \text{ lb-BOD} / \text{d} \cdot 1000 \text{ ft}^3$$

$$\text{MLSS: } 1500 - 3000 \text{ mg/L}$$

Ex:

$$200 \frac{\text{mg}}{\text{L}} \text{ BOD} \times \frac{62.4 \frac{\text{lb}}{1000 \text{ ft}^3}}{1000 \frac{\text{mg}}{\text{L}}} = 12.5 \frac{\text{lb}}{1000 \text{ ft}^3}$$

$$12.5 \frac{\text{lb}}{1000 \text{ ft}^3} \times \frac{24 \text{ h/d}}{6 \text{ h}} = 50 \frac{\text{lb}}{\text{d} \cdot 1000 \text{ ft}^3}$$

$$\text{F/M: BOD LOAD} = (200 \text{ mg/L})(8.34)(1 \text{ MGD}) = 1660 \text{ lb/d}$$

$$\text{F/M} = \frac{\text{lb-BOD/d}}{\text{lb-MLSS}} \quad \text{SO EITHER } \textcircled{1} \text{ SET F/M \& find MLSS}$$

(E.g. MLSS = 3200 mg/L  
FIND F/M)

OR  $\textcircled{2}$  SET MLSS, FIND F/M

# TYPICAL OPERATING PARAMETERS

LOAD:  $38-50$  <sup>mg/l</sup>  $\frac{15300}{1000 \text{ ft} \cdot \text{d}}$

SLUDGE AGE: 5-15 days

AERATION: 5-8 hr  $50 \text{ mg/l}$

SLUDGE RETURN RATIO: 0.3-0.6

MLSS: 1500 - 3000 (sometimes even to 5000  $\text{mg/l}$ )

*Same as Table 12.3 (Arest)*

**Table 12.3** General Loading and Operational Parameters for Activated-Sludge Processes

PROCESS	BOD LOADING		SLUDGE AGE (days)	AERATION PERIOD (hr)	AVERAGE RETURN SLUDGE RATES (%)
	lb BOD/1000ft <sup>3</sup> /day <sup>a</sup>	lb BOD/day/lb of MLSS			
Step aeration	30-50	0.2-0.5	5-15	5.0-7.0	50
Conventional (tapered aeration)	30-40	0.2-0.5	5-15	6.0-7.5	30
Contact stabilization	30-50	0.2-0.5	5-15	6.0-9.0	100
Extended aeration	10-30	0.05-0.2	20+	20-30	100
High-purity oxygen	120+	0.6-1.5	5-10	1.0-3.0	30

<sup>a</sup>1.0 lb/1000 ft<sup>3</sup>/day = 16 g/m<sup>3</sup>·d.

*From Viestman & Hammer*

*Faint, illegible text from the original document, possibly bleed-through or a second page.*

$$V = 120,000 \text{ ft}^3 = 0.898 \text{ MG}$$

$$\text{FLOW} = 3.67 \text{ MGD}$$

$$\text{RTN SLUDGE} = 1.27 \text{ MGD}$$

$$\text{WASTE SLUDGE} = 18,900 \text{ gpd} = 0.0189 \text{ MGD}$$

$$\text{MLSS} = 2350 \text{ mg/L}$$

$$\text{Sludge}_{\text{SS}} = 1.1\% = 11,000 \text{ mg/L}$$

$$\text{Influent}_{\text{BOD}} = 128 \text{ mg/L}$$

$$\text{Effluent} = 22 \text{ mg/L (BOD)}; 26 \text{ mg/L (TSS)}$$

$$\text{BOD LOAD} : 3.67 \times 128 \text{ mg/L} \times 8.34 = 3920 \text{ lb/d}$$

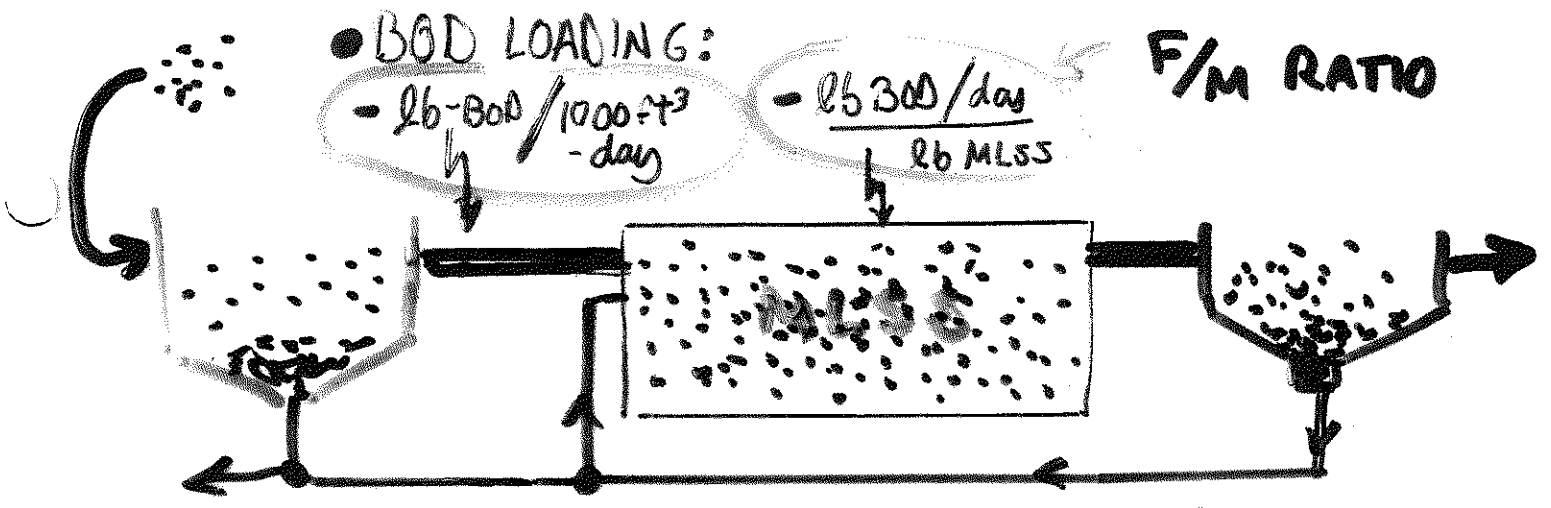
$$\text{BOD LOADING} = 3920 / 120 \text{ thous. ft}^3 = 32.7 \text{ lb/d/1000ft}^3$$

$$\text{SLUDGE AGE} = \frac{2350 \text{ mg/L} \times 0.898 \text{ MG}}{26(3.67) + 11,000(0.0189 \text{ MG})} = 7.0 \text{ d}$$

$$\text{AERATION PERIOD} = \frac{0.898 \text{ MGD} \times 24 \text{ hr/d}}{3.67} = 5.9 \text{ hr}$$

$$\text{RTN RATE} = \frac{1.27 \times 100}{3.67} = 35\%$$

$$\text{BOD Removal} = (128 - 22) / 128 = 83\%$$



**MAIN GOVERNING PARAMETERS OF ACTIVATED SLUDGE UNIT DESIGN**

• AERATION PERIOD (Detention Time)

• SLUDGE AGE (MEAN CELL RESIDENCE TIME)

CONVERSION:  $\text{BOD} \frac{\text{mg}}{\text{L}} \times \frac{62.4}{1000} = \text{BOD} \frac{\text{lb}}{1000 \text{ ft}^3}$

$\left( \text{BOD} \frac{\text{lb}}{1000 \text{ ft}^3} \right) \times \left[ \frac{24 \text{ h/d}}{t_d, \text{h}} \right] = \text{LOADING IN} \frac{\text{lb BOD}}{1000 \text{ ft}^3 \cdot \text{d}}$

$$\text{SLUDGE AGE} = \frac{\text{MLSS} \left( \frac{\text{mg}}{\text{L}} \right) \times V (\text{L})}{\left[ \text{SS}_e \left( \frac{\text{mg}}{\text{L}} \right) \times Q_e \left( \frac{\text{L}}{\text{d}} \right) \right] + \left[ \text{SS}_w \left( \frac{\text{mg}}{\text{L}} \right) \times Q_w \left( \frac{\text{L}}{\text{d}} \right) \right]} = \frac{\text{mg of MLSS}}{\text{mg-solids "lost" day}}$$

Typically 5-15 days → = days spent in system

# TYPICAL OPERATING PARAMETERS

LOAD: 30-50  $\frac{16 \text{ BOD}}{1000 \text{ ft}^2 \text{ d}}$

SLUDGE AGE: 5-15 days

AERATION: 5-8 hr 50 mg/L

SLUDGE RETURN RATIO: 0.3-0.6

MLSS: 1500 - 3000 (sometimes even to 5000 mg/L)

**Table 12.3** General Loading and Operational Parameters for Activated-Sludge Processes

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